

# Maternal Outcomes After Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection in Vaccinated Compared With Unvaccinated Pregnant Patients

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## INTRODUCTION

In early July 2021, the Centers for Disease Control and Prevention reported that the Delta (B.1.617.2) variant of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) became the dominant strain in parts of the United States, leading to a fourth surge in cases.<sup>1</sup> Areas with low vaccination acceptance experienced high community-infection rates, thus contributing to an increase in SARS-CoV-2 infections in fully vaccinated individuals (breakthrough infection).<sup>1,2</sup>

Recent data from the Centers for Disease Control and Prevention suggest that two-dose mRNA vaccine effectiveness against SARS-CoV-2 infection is decreasing in the context of the Delta variant surge; however, the vaccine remains protective against severe sequela of SARS-CoV-2 infection.<sup>3–5</sup> Pregnancy is an independent risk factor for severe coronavirus disease 2019 (COVID-19); however, it is currently unknown whether pregnant patients with breakthrough infection remain at high risk for severe disease.<sup>6</sup> The primary objective of this study is to

evaluate the incidence of severe or critical COVID-19 in vaccinated compared with unvaccinated pregnant patients in the context of Delta variant predominance.

## METHODS

This is a retrospective cohort study of all active pregnancies in the Ochsner Health System between June 15, 2021, and August 20, 2021. This study was approved by the Ochsner Clinic Foundation Institutional Review Board on August 8, 2021. Patients were compared according to vaccination status. The vaccinated group included patients who were fully vaccinated 2 weeks before the start of the study period. Vaccine status was confirmed objectively using LINKS, a state-wide immunization reporting network that can be accessed only by health care professionals. Race was included in our demographic comparison to identify potential disparities in vaccine access and acceptance. The primary outcome was development of severe or critical COVID-19 based on National Institutes of Health criteria.<sup>7</sup> Severe illness is defined as SpO<sub>2</sub> less than 94% on room air, PaO<sub>2</sub>/FiO<sub>2</sub> ratio less than 300 mm Hg, respiratory rate greater than 30 breaths per minute, or lung infiltrates greater than 50%.<sup>7</sup> Critical illness is defined as respiratory failure, septic shock, or multiple organ failure.<sup>7</sup> Secondary outcomes included SARS-CoV-2 infection, supplemental oxygen requirement, intensive care unit admission, and use of adjunctive medical therapy. A secondary analysis of the cohort was performed, including those who were partially vaccinated. Student's *t* test, Wilcoxon rank sum test,  $\chi^2$  test, Fischer exact test, and logistic regression were used when appropriate.  $P < .05$  is considered statistically significant.

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Each author has confirmed compliance with the journal's requirements for authorship.

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## RESULTS

A total of 10,092 pregnant patients were included in the study. There were 1,332 vaccinated patients and 8,760 incompletely vaccinated or unvaccinated patients, a 13.2% vaccination rate. Younger age, lower body mass index (BMI, calculated as weight in kilograms divided by height in meters squared), current smoking, and race were associated with unvaccinated status (Table 1). Vaccinated patients had lower odds of severe or critical COVID-19 (0.08% vs 0.66%, adjusted odds ratio [aOR] 0.10, 95% CI 0.01–0.49) and COVID-19 of any severity (1.1% vs 3.3%, aOR 0.31, 95% CI 0.17–0.51) (Table 2). Despite the lack of statistical significance for secondary outcomes, the use of adjunctive medical therapy was rare for vaccinated patients, and no vaccinated patients needed supplemental oxygen or intensive care unit admission (Table 2). Additionally, in the unvaccinated group there was one maternal death secondary to COVID-19 complications and six stillbirths, three of which occurred in patients who had SARS-CoV-2 infection earlier in the gestation. There were a total of 1,536 vaccinated patients in the secondary analysis, which included both fully and par-

tially vaccinated patients (n=204, 2% partial vaccination rate). When including all partially vaccinated patients who received any doses of the vaccine before the study, an association between vaccinated status and lower odds of severe or critical COVID-19 (0.07% vs 0.68%, aOR 0.08, 95% CI 0.004–0.40) and COVID-19 of any severity (1.1% vs 3.3%, aOR 0.30, 95% CI 0.17–0.48) remained.

## DISCUSSION

Our study shows an association between SARS-CoV-2 vaccination and lower odds of severe or critical COVID-19 and COVID-19 of any severity in pregnant patients during the Delta variant–predominant fourth surge of SARS-CoV-2. A possible limitation of our study is the lack of data on positive SARS-CoV-2 test results or treatment of SARS-CoV-2 infection performed outside of the Ochsner Health System, or both, within the study population. This study also identified a low vaccination rate among pregnant patients (13.2%); unvaccinated status was associated with younger age, current smoking, lower BMI, and race. As nationwide efforts to improve vaccination acceptance continue,<sup>8,9</sup> it is vital for obstetricians and gynecologists to educate vulnerable populations

**Table 1. Demographics for Pregnant Patients With Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection Between June 15, 2021, and August 20, 2021 (N=10,092)**

Demographic	Vaccinated (n=1,332)*	Unvaccinated (n=8,760)	P
Age (y)	32.1±5.9	27.8±4.9	<.01
Self-reported race			<.01
Black, non-Hispanic	308 (23.1)	3,653 (41.7)	
Hispanic	90 (6.8)	637 (7.3)	
Not reported	31 (2.3)	455 (5.2)	
Other <sup>†</sup>	78 (5.9)	266 (3.0)	
White, non-Hispanic	825 (61.9)	3,749 (42.8)	
Prepregnancy BMI (kg/m <sup>2</sup> )	28.8±7.32	30.4±8.1	<.01
Current smoker	25 (1.9)	853 (9.7)	<.01
Comorbidities			
Diabetes	22 (1.7)	180 (2.1)	.38
Hypertension	79 (5.9)	614 (7.0)	.16
Cardiac disease	70 (5.3)	350 (4.0)	.03
HIV	0 (0)	10 (0.1)	.37
Asthma	71 (5.3)	373 (4.3)	.08
Vaccine type <sup>‡</sup>			
Pfizer	883 (66.3)		
Moderna	382 (28.7)		
Janssen	67 (5.0)		

BMI, body mass index; HIV, human immunodeficiency virus.

Data are mean±standard deviation or n (%) unless otherwise specified.

\* Table 1 includes the primary analysis; all patients received the full course of the elected vaccine series at least 2 weeks before the start of the study period, with a cutoff date of May 30, 2021 (one dose for Janssen and two doses for mRNA vaccine). N for secondary analysis including both fully and partially vaccinated patients=1,536.

<sup>†</sup> Patients of the following races were specified as Other in the study database: American Indian, Asian, Indian (from India), Middle Eastern (Arabic), and Mixed Race.

<sup>‡</sup> Vaccine type when including partial vaccinations: Pfizer n=996 (64.8); Moderna n=473 (30.7); Janssen n=67 (4.3).



**Table 2. Clinical Outcomes for Pregnant Patients With Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) Infection Between June 15, 2021, and August 20, 2021 (N=10,092)**

Outcome Data	Vaccinated (n=1,332)	Unvaccinated (n=8,760)	aOR (95% CI)*	OR (95% CI)*
Primary outcome				
Severe or critical COVID-19 <sup>†</sup>	1 (0.08)	58 (0.66)	0.10 (0.01–0.49)	
Secondary outcomes				
Severe COVID-19 <sup>†</sup>	1 (0.08)	53 (0.61)	0.11 (0.01–0.53)	
Critical COVID-19 <sup>†</sup>	0 (0)	5 (0.05)		0 (0–7.1)
Positive SARS-CoV-2 infection <sup>†</sup>	15 (1.1)	291 (3.3)	0.31 (0.18–0.51)	
Stillbirth <sup>‡</sup>	0 (0)	6 (0.07)		0 (0–4.73)
Maternal death	0 (0)	1 (0.01)		0 (0–651)
Supplemental oxygen	0 (0)	20 (0.2)		0 (0–4.07)
ICU admission	0 (0)	5 (0.6)		0 (0–19.35)
Remdesivir	1 (0.08)	20 (0.23)		0.32 (0.01–2.05)
Dexamethasone	1 (0.08)	34 (0.4)		0.18 (0.04–1.15)
Tocilizumab	0 (0)	3 (0.03)		0 (0–15)

aOR, adjusted odds ratio; OR, odds ratio; COVID-19, coronavirus disease 2019; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2, ICU, intensive care unit.

Data are n (%) unless otherwise specified.

\* Logistic regression analysis was used to calculate an adjusted odds ratio for all statistically significant outcomes to control for age, race, body mass index, and current smoking. Adjusted odds ratios were not reported for nonstatistically significant outcomes owing to large CIs. Low total number of adverse events for nonsignificant secondary outcomes allowed insufficient statistical power to generalize nonsignificant findings.

<sup>†</sup> According to National Institutes of Health definition.<sup>7</sup>

<sup>‡</sup> *Stillbirth* is defined as nonanomalous fetal death after 20 weeks of gestation.

on the potential benefits of the SARS-CoV-2 vaccine in preventing severe or critical illness.

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